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Veröffentlichungsversion / Published Version
Zeitschriftenartikel / journal article

Zur Verfügung gestellt in Kooperation mit / provided in cooperation with:
Wissenschaftszentrum Berlin für Sozialforschung (WZB)

Empfohlene Zitierung / Suggested Citation:
Fregin, M.-C., Levels, M., & Velden, R. v. d. (2020). Labour market institutions and the challenge of allocating the right people to the right jobs: Evidence on the relation between labour market institutions and optimal skill matching from 28 industrial countries. *Compare: A Journal of Comparative and International Education*, *50*(2), 257-275. https://doi.org/10.1080/03057925.2019.1695197

COMPARE, 2020
VOL. 50, NO. 2, 257–275
https://doi.org/10.1080/03057925.2019.1695197

Routledge
Taylor & Francis Group

Labour market institutions and the challenge of allocating the right people to the right jobs: Evidence on the relation between labour market institutions and optimal skill matching from 28 industrial countries

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ABSTRACT

This article provides empirical evidence on the relation between institutional characteristics of labour markets that frame allocation processes, and optimal skill matching at the individual level. We investigate the extent to which skill-based job-worker matches are associated with employment protection legislation (EPL), unemployment benefits, and enforcing and enabling activating labour market policies. Drawing on data of the OECD's Programme for the International Assessment of Adult Competencies (PIAAC), and performing cross-country analyses of 28 industrial countries, we find that EPL can explain variance in the share of optimal skill matching across countries, displaying a positive relation. We also find a negative relation between strict enforcing activating labour market policies and optimal skill matching.

KEYWORDS

Skills; mismatch; allocation; social policy; labour market policy; institutions

Introduction

Against the background of technological developments and changing demands for skills, the allocation of the right people to the right jobs and a full usage of talent have become more important as an issue of scientific but also political and societal concern. During the last decades many countries engaged in reforms of labour markets and social policies (Barbieri, Cutuli, and Passaretta 2018; Ochsenfeld 2018), aiming – among other things – at a better alignment of labour market demands and skills supply. However, suboptimal matches between workers' skills and skill requirements of jobs seem to have increased in number over time (European Commission 2013; Verhaest and van der Velden 2013). This may be due to imbalances between supply and demand as well as to dynamics in the demand for skills: technological developments change job requirements so rapidly that education and training systems are unable to keep pace (Allen and van der Velden 2002). However, cross-country variation suggests that worker-to-job matches may be related

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Supplemental data for this article can be accessed here.

with institutions that shape the allocation of workers to job (Levels, van der Velden, and Di Stasio 2014a; Levels, van der Velden, and Allen 2014b; Green 2013; Van der Velden and Wolbers 2003). Labour market institutions seem to be of particular theoretical relevance when it comes to optimal skill matching as they may explain variation in allocation processes (Barbieri 2009; Gangl 2006, 2004; Estévez-Abe, Iversen, and Soskice 2001; Hall and Soskice 2001). In the literature, there is a common understanding that employment protection legislation favours established employees ('labour market insiders'; Lindbeck and Snower 1988), leading to a situation in which particularly young workers are confronted disproportionally with adverse labour market situations and related risks (Ochsenfeld 2018; Giesselmann 2014; De Vreyer et al. 2000). The institutional arrangements of labour markets (and especially unemployment benefit schemes) have been reconfigured during the last decades, particularly during the 'activation turn', a paradigm shift that was accompanied by deregulation and increasing flexibility (Bonoli 2010). Activating labour market policies involve a combination of policies that *enforce labour market participation*, and services that promote employability and *enable individuals* to find their way into employment (Dingeldey 2007, 823; Gilbert 2002). The consequences of the 'activation turn' are not fully understood yet.

Our study empirically tests the relation between labour market institutions and *optimal skill matching* at the individual level. We pose the following research question: *To what extent can the likelihood that workers find a job for which they have the right skills be explained by characteristics of labour market arrangements?*

To answer this question, we analyse data from the OECD's Programme for the International Assessment of Adult Competencies (PIAAC). PIAAC is an international comparative assessment of cognitive and workplace skills of adults aged 16–65. Our analyses rely on objective skills measurements for employees in 28 industrialised countries.[1] We enrich the PIAAC microdata with measures of social policies at the country level, more specifically, the *degree of employment protection (EPL), unemployment benefits*, and *activating labour market policy (ALMP)* of labour markets. While we base our analyses on statistical models for workers of all ages, we put a specific focus on the situation of young workers, comparing their situation to prime age and older workers (Ochsenfeld 2018; Fregin 2017; Palier and Thelen 2012; Giesselmann 2014; Lindbeck and Snower 1988). We do so because young workers form a specific group of workers as they have to compete for available jobs with those who have already gained experience with work and employment (e.g. De Vreyer et al. 2000).

Our article advances the literature in two main ways. First, the analyses presented here are the first to explain the extent to which cross-country variance in optimal skill matching at the individual level is related to labour market institutions at the country level. As such, our article is descriptively important. We provide a solid basis for future analyses of the causal impact of the various policies on worker-to-job skills matches. Second, our focus on optimal *skill* matching particularly seeks to advance the literature on *educational* matches. The match between workers and jobs is usually conceptualised by measuring education-to-job matches (e.g. Gangl 2004). Indicators that are based on detailed information about skills instead of education certificates provide a better and more dynamic picture of an individual's human capital and job-worker matches (e.g. Allen, Levels, and van der Velden, 2013b; Levels, van der Velden, and Allen 2014b). To contribute to this literature, we examine the relation between

optimal skill matches and institutional characteristics. We also test institutional features other than those usually tested, using composite indicators that capture enforcing vs. enabling activating labour market policies (Knotz 2012).

How are labour market institutions related to optimal skill matching? – Theory and hypotheses

Previous studies exploring the relation between labour market policies and individual outcomes seldom look at skill-based job-worker matches (McGowan and Andrews 2015) but focus, e.g. on employment chances, school-to-work transitions, wages or type of contract (e.g. Barbieri, Cutuli, and Passaretta 2018; Ochsenfeld 2018; Van der Velden and Wolbers 2003). Studies that investigate the relation between institutional contexts and labour market matching mainly focus on education-to-job matches instead of skill matches (e.g. Levels, van der Velden, and Di Stasio 2014a; Levels, van der Velden, and Allen 2014b). Besides, the existing literature on skill matching mainly addresses the impact of education system characteristics, often ignoring labour market policies (e.g. Heisig and Solga 2014).

By contrast to previous studies, our paper is about 'optimal skill matching'. Treating both workers and jobs as a given, this term defines a situation, in which, in a country, the workers with the highest skills are allocated to the jobs with the highest skill requirements, and the workers with the lowest skills are allocated to the low-skilled jobs. From a societal point of view, this would be the most optimal way of matching workers to jobs. Any disturbance in this rank order leads to suboptimal matching, where workers are relatively over- or underskilled for their jobs. This prevents countries from an optimal allocation of the right worker to the right job, leading to a situation in which the available skills of the available workforce are not put to optimal use. Hereby, more disturbance means more suboptimal and hence less optimal matches. Ranking both workers and jobs from low skill (requirements) to high in a one-dimensional order, the following graph illustrates the idea (for more information see methods section).

From a societal point of view, social policies, and particularly labour market policies, should have a role in making sure that countries have an optimal match situation, seeking to ensure an optimal social outcome. We, therefore, explore how optimal skill matching relates to institutional factors at the national level. Various aspects of welfare states are important for explaining optimal skill matching, the most important ones being (i) employment protection, (ii) unemployment benefits, and (iii) non-financial services (Schmid 2010). We investigate aspects of all three dimensions.

Employment protection

The degree of employment protection has a major impact on individual labour market outcomes (Barbieri, Cutuli, and Passaretta 2018). This is especially true for employment protection legislation (EPL), i.e. legal schemes of procedures and costs involved in worker dismissals. The 'overall strictness of EPL continues to vary widely between countries and [...] remains the key element in explaining cross-country differences' (OECD 2004, 63). The higher the protection against dismissal, the higher the firing costs even with workers that

are mismatched and not optimally productive. One could, therefore, hypothesise that the harder it is to fire someone the more likely it is that mismatched workers remain in their jobs. However, the regulation of the dismissal process also affects hiring processes. Job security provisions such as EPL increase hiring risks on the side of the employer. During the allocation process, employers must anticipate paying dismissal costs, assessing how likely it is that these risks arise in practice, for example, because a worker turns out to be less productive than initially expected (Noelke 2011, 4). Dismissal costs would lower the expected returns and diminish the utility of hiring. Generally, employers tend to be rather risk averse, seeking to realise expected returns. The higher the costs for dismissals, the more employers will ensure that their workers match their jobs, which, at the aggregate level, makes a positive relation between stricter EPL and optimal skill matching more likely than a negative relation. In countries with a high EPL, we therefore expect that employers try either to find persons that match their jobs or invest in training for workers that they already hired, as EPL makes re-allocation costlier for employers. Based on this reasoning, we hypothesise that:

H1.The stricter the degree of employment protection legislation is, the more likely it is that workers are allocated to jobs that match their skill level, i.e. the higher the share of optimal skill matching.

As labour market deregulation took part selectively and was directly targeted at labour market entrants (Ochsenfeld 2018), it is unlikely that EPL affects all age groups in the same way. By contrast, we would expect that EPL affects young workers stronger than prime age and older workers. We, therefore, further specify our argument for young workers, developing additional hypothesis H1a. Restricting our argument to young workers, we capture moderating effects of employment protection through the introduction of a cross-level interaction between EPL and young age, hypothesising:

H1a.The stricter the degree of employment protection legislation is, the more likely it is that particularly young entrants to the labour market are allocated to jobs that match their skill level, i.e. the higher the share of optimal skill matching.

Unemployment benefits

With reference to globalisation and changing demands for skills, social and labour market policies have changed the institutional framework of employment towards a more liberal configuration and de-commodification (Dingeldey 2007, 2011; Gilbert 2002). From a micro-level perspective, the conditioning of social rights reinforced economic self-reliance and risks (Giesselmann 2014). De-commodification is defined as welfare state generosity regarding unemployment benefits. More generous unemployment benefits are theoretically thought to permitting the unemployed more time to find a job that matches their skills (Estévez-Abe, Iversen, and Soskice 2001). We therefore hypothesise:

H2.The more generous unemployment benefits are, the more likely it is that workers are allocated to jobs that match their skills, i.e. the higher the share of optimal skill matching.

Services and activating labour market policies (ALMPs)

While governments use cutbacks in financial transfers as a straightforward way of improving the sustainability of social insurance schemes, enabling services such as lifelong training turn out to be a core area of reform programs in many countries. Enabling policies should increase the share of optimal skill matching, as e.g. unemployed adults are purposefully (re-)trained to acquire skills that fit labour market demands. A country's overall effort in ALMPs finds expression in the amount of public spending for these policy measures. We test the overall effort in activating labour market policies across countries (OECD 2013c), hypothesising:

H3.The more countries invest in activating labour market programmes, the more likely it is that workers are allocated to jobs that match their skills, i.e. the higher the share of optimal skill matching.

Activating labour market policy programmes include a diverse pool of measures, ranging from re-skilling and lifelong training to the promotion of atypical, and sometimes even precarious, forms of employment. We expect that diverse measures are differently related to optimal skill matching; some of them enhancing the chances of optimal matches, others, by contrast, increasing suboptimal matches and related labour market risks. We, therefore, take a closer look at the combination of enabling and enforcing ALMPs, whereby the latter seek to tighten readiness-to-work requirements and suitability criteria, which usually comes along with cuts in the access to unemployment benefits (Estévez-Abe, Iversen, and Soskice 2001). As persons are forced into employment irrespective of the match between the job and the worker, we expect that:

H4a.The more enforcing ALMPs are in effect, the less likely it is that workers are allocated to jobs that match their skills, i.e. the lower the share of optimal skill matching.

Enforcing policies are usually accompanied by services to assist people on their way into the labour market. These 'enabling' policies include the expansion of training and upskilling, but also policies facilitating the compatibility of paid and care work and, e.g. job counselling. As enabling policies are designed to support people to find a job that matches their skills, we hypothesise:

H4b.The more enabling ALMPs are in effect, the more likely it is that workers are allocated to jobs that match their skills, i.e. the higher the share of optimal matching.

Data and methods

We use data of the Survey of Adult Skill from the OECD's Programme for the International Assessment of Adult Competencies (PIAAC; see OECD 2016a, 2016b). For PIAAC, representative samples of the workforce aged 16–65 were tested in key skills related to information processing at work and in daily life. The survey conducted computer-based assessments in different skill domains such as literacy and numeracy in many industrial countries. PIAAC provides unique possibilities to investigate optimal

skill matching as it contains individual level data about cognitive and workplace skills and a large amount of background information.[2] PIAAC deploys a use-oriented, functional skills framework that involves managing a situation or solving a problem in a real context. For our analyses, we take numeracy skills as proxy for general key information-processing skills that can be deployed at the workplace at all proficiency levels from very basic to very complex. The PIAAC numeracy domain captures the general cognitive ability to grasp meaning and relevant new information which is presented in numerical sense (OECD 2016a). Previous research has shown that numeracy is the single most important skill that workers need to have when explaining returns to skills (Levels, van der Velden, and Allen 2014b).

For our analyses, we draw the following sample selection: As allocation processes and labour market engagement may be different for part-time workers, we restrict our working sample to full-time workers (which we define as working 30 h or more per week).We furthermore restrict our analyses to male workers as the labour market activity of women, especially of older generations, is much different from that of men. However, we conduct additional analyses for female workers. We exclude self-employed, members of the armed forces, unpaid family workers and students/interns as for these workers the allocation process is different from employees. We further exclude four PIAAC countries either because data are missing for the country-level variables (Singapore and Cyprus), data confidentiality issues (Australia) or data quality issues (Russian Federation). As the Canadian sample is much bigger than the other countries' samples, we select a random sample of Canada's respondents to avoid overrepresentation in our dataset. Our analyses are thus based on a dataset that contains representative samples of male full-time working employees for 28 industrial countries based on microdata for 39,041 individuals (for sample statistics and a full list of countries, see supplemental material, Tables A1–A3).

Measuring optimal skill matching

Focussing on optimal skill matching in the domain of numeracy, we use an indicator that captures individual skill match as micro level dependent variable that we deploy in all analyses. In the literature, there is no agreement on how to measure skill matching.[3] As PIAAC measures *skill proficiency levels*, we focus on the vertical dimension of matches, i.e. optimal matching at the level of skills, which is different from horizontal field of study matches.

As outlined in the introductory section, we treat both workers' skills and job skill requirements as a given and define optimal skill matching (that is perfect allocation) as a situation, in which the workers with the highest skill levels are allocated to the jobs with the highest skill requirements and vice versa. To illustrate this, think of the following example (see Figure 1). Suppose we can rank all workers in a country on the basis of their skill levels from high to low. And we can also rank all jobs on the basis of their skill requirements from high to low. An optimal allocation would then be defined as the situation in which both rank orders correlate perfectly, and the match is thus 100%. However, this is seldom the case as there are disturbances in this allocation process, which we here refer to as suboptimal skill matching. We expect the amount of optimal skill matching to differ between countries as a result of differences in institutional factors that may disturb the optimal allocation.

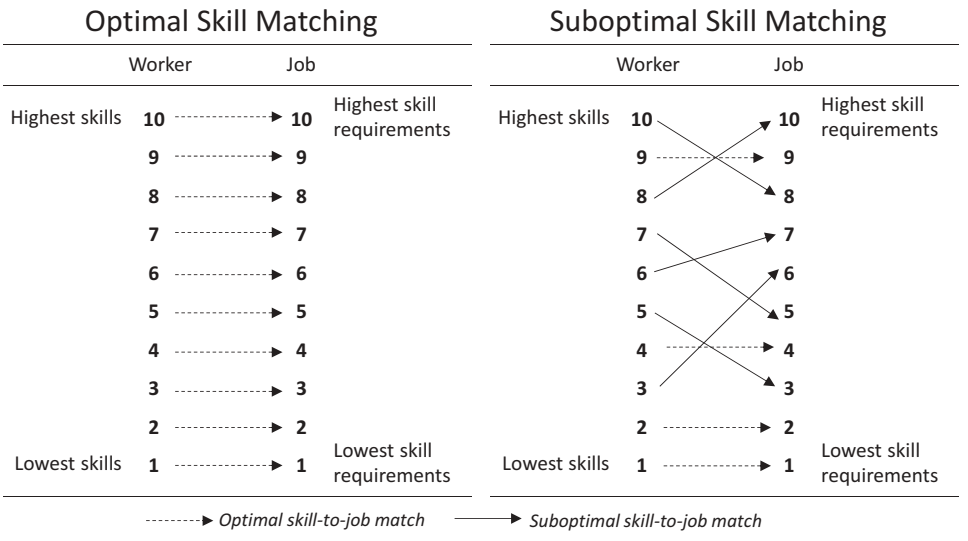

Figure 1. Illustration of the idea of optimal vs. suboptimal skill matching (Source: own graph).

In practice, an optimal allocation cannot be directly observed as we do not have direct information on the skill requirements of all individual jobs. Instead, we proxy optimal matching using the so-called Realised Matches Approach (RMA; Van der Velden and Bijlsma 2018; Flisi et al. 2014, 2016; Perry, Wiederhold, and Ackermann-Piek 2014). The RMA defines a worker as well-matched if the worker has a skill proficiency level of – usually – not more than one standard deviation above or below that occupation-specific level (e.g. Perry, Wiederhold, and Ackermann-Piek 2014). Thereby, the cut-off point of one standard deviation is chosen as it captures approximately the distance between two proficiency levels in PIAAC (OECD 2016a, 2016b). We follow this approach, defining a corridor between one standard deviation above and below the robust-required skill level of each occupation-country-cell to identify well-matched workers. If the skill level of a worker lies outside that corridor, we classify the respective worker as mismatched, i.e. misallocated by level of skill.[4] This approach has the attractive feature that the average worker in an occupation is defined as well-matched, just like we assume in the optimal skill matching model.

Model specification and micro-level confounders

Our skill match measure is based on the actual skill distribution and the required skill levels for each ISCO 2-digit occupation in each country. To estimate robust average skill proficiency levels for each of these occupations, we make use of calculations performed by Allen and Bijlsma (forthcoming).[5] This is necessary because several ISCO groups at the 2-digit level in PIAAC are very small.[6] Allen and Bijlsma (forthcoming) effectively tackle this problem by computing robust estimates of the average skill level in each occupation-country-cell. These robust estimates are partly based on information from other countries than the reference country. This procedure might introduce some bias, as countries differ regarding the occupational and sectoral structure of their labour markets.

We effectively control for this bias by introducing occupational structure (1-digit ISCO classification) and sector of industry (1-digit ISIC classification) of each country as controls in all statistical models.

To take into account composition effects wherever applicable, we run all our models twice, (1) *without* and (2) *with* micro-level confounders. Although our optimal skill matching model should work irrespective of worker characteristics, certain characteristics typically are a prerequisite to enter certain jobs. That holds primarily for educational level as minimum educational credentials are often required to enter a certain occupation. A second prerequisite is often age as some jobs can only be entered with a certain work experience, e.g. management. Finally, employers might find it difficult to judge qualification levels and productivity adequately for workers with a migration background as skills may be less observable for migrants (Seibert and Solga 2005). Countries differ in the composition of the workforce, which may disturb optimal skill matching. To ensure that the correlations that we find are not driven by composition effects, we re-run all our main models including age, age squared (to control for non-linear age effects), migration background and highest level of education as micro level confounders. In our working sample, the average age is 40.3 years, with a range from 15 to 65. To operationalise migration background, we make use of a binary indicator, comparing first- and second-generation migrants with non-immigrants, finding that 12% of the workers in our sample have a migration background. The indicator that we use to operationalise educational attainments defines three levels (measured based on educational credentials) and differentiates between compulsory education (16% of the sample), secondary education/apprenticeship (59% of the sample) and tertiary education (25% of the sample; for descriptive statistics see Tables A2 and A3 in the supplemental material).

To test hypothesis H1a, we use a specific model with a cross-level interaction between EPL and young age. Assessing the robustness of our findings, we re-run our main models leaving out one country at a time and repeat the main models (EPL and enforcement) including a random slope at the country level. Furthermore, we compute our main models separately for young vs. prime age and older workers, private vs. public sector employees, and for non-immigrants only. We perform additional analyses for full-time working women.

Measuring labour market policies

We merge institutional characteristics collected in appropriate macro-datasets on the country level with PIAAC microdata. This combined, hierarchical dataset enables us to model the macro- and micro-variables simultaneously, testing the hypotheses in multilevel models (Snijders and Bosker 2012).

The information on the macro level originates from different sources. Most macro level indicators that we use describe the situation in the year in which the PIAAC survey was conducted. PIAAC ran from 2011–2014. For each country, we use macro data from the year in which PIAAC was conducted in the respective country. Only the indicators for enforcement and enablement (Knotz 2012) display the situation in the mid-2000s, as this is the only point in time available.

To capture labour market institutions, we make use of several indicators that are commonly used in this type of research. We use an index for *employment protection legislation (EPL)* for permanent contracts as proxy for the degree of regulation (OECD 2018). This indicator as provided by the OECD (2018) is the weighted sum of sub-indicators concerning the regulations for individual dismissals (weight of 5/7) and additional provisions for collective dismissals (2/7). It incorporates 13 detailed data items. The indicator is available for all 28 countries in our analyses, and has a range from 1 to 3, with a mean of 2.3 with a standard deviation of 0.5.

Regarding *unemployment benefits* we use the state-of-the-art indicator for average net replacement rates during the first 5 years of unemployment as percentage of previous net income (OECD 2013c). The indicator captures the average net replacement rate over 60 months following unemployment for a one-earner couple with two children, where the earner previously earned the average wage (OECD 2013c). This indicator is available for all our 28 countries. It has a range from 9 (min) to 83 (max), a mean of 57 with a standard deviation of 18.

The information on *public expenditure on active labour market policies* is also provided by the OECD (2013a). It captures the total amount of public spending as percentage of GDP.[7] For this indicator, the latest data is available for 2011 and it is only available for 23 countries. The indicator has a range of 0 to 2.3, a mean of 0.7 with a standard deviation of 0.6.

The indicators that we use to operationalise enforcement and enablement stem from Knotz (2012). Inspired by Esping-Andersen's (1990) decommodification index, Knotz (2012) provides composite indicators that quantify the mix of enforcing and enabling measures that characterises ALMP schemes in an international comparison. The author constructs two composite indices, quantifying the strengths of enabling versus enforcing policies across countries (for details see Knotz 2012). The data display the situation in 17 PIAAC-countries. The unique composite indicators quantify activation strategies, which are defined as configurations of ALMPs, passive benefit systems, and all related policies (e.g. family and tax policies). The author combines financial and non-financial policy measures for both enforcement and enablement and combines them into composite indicators, quantifying ALMPs that are designed to activate unemployed and inactive persons to search for and take up employment (Knotz 2012: 12 et seq.). Enforcement has a min of 0.5 and a max of 0.8, with a mean of 0.6 and a standard deviation of 0.01. Enablement has a slightly larger range of 0.2 to 0.65, with a mean of 0.4 and a standard deviation of 0.1. We use the indicators provided by Knotz (2012) in addition to the above mentioned, commonly used measures, as they allow us to capture a more detailed picture of ALMP schemes across countries.[8]

Analyses

We start our analyses with descriptive results on the cross-country univariate distribution of skill matching. Thereafter, we perform the above outlined multilevel analyses to explore the relation between labour market institutions and optimal skill matching. Thereafter, we provide the results of robustness checks, including analyses for different subgroups of workers.

We estimate multilevel mixed-effects logit regression models (using the melogit-command in Stata 15). Defining π_{ij} = Pr(match$_{ij}$= 1), we use the following Equation (1):

$$\text{logit}(\pi_{ij}) \;= A_j\beta + B_{ij}\gamma\left(+X_{ij}\delta\right) + u_j + \epsilon_{ij} \tag{1}$$

for j= 1; . . . ; 28 countries, with i= 1; . . . ; n_j fulltime working male employees in countries j. A_j is a vector that contains country-level variables, i.e. the characteristics of labour market policies that we described in the theoretical section. The vector B_{ij} contains a constant as well as ISCO-1 digit and ISIC-sector dummies, which we use as basic controls on the individual level in all our statistical models. X_{ij} is the vector containing our micro-level characteristics that we include when we repeat our models. If not stated differently in the tables, the vector includes age, age squared, educational attainment, and migration background. All our main analyses are based on Equation (1). Only for the analysis referring to Hypothesis H1a we extend X_{ij} adding a fixed effect of a dummy indicating young worker, a cross-level interaction with EPL, and a random slope at the country level. The errors ϵ_{ij} are assumed to be distributed as logistic with mean 0 and variance $\pi^2/3$ and are assumed to be independent of country random effects u_j.

All analyses are weighted using a 'rescaling to cluster size' approach, with which we account for different sample-sizes between countries by adjusting the overall sample weight in PIAAC. To evaluate the goodness of fit of our statistical models, we conduct deviance tests (Snijders and Bosker 2012, 97).

Results

We start our empirical analyses assessing the amount of optimal vs. suboptimal skill matching across countries. As outlined above, we restrict our main analyses to male fulltime working employees. Figure 2 displays the proportions of workers in our sample who have skills that match their jobs across countries compared to the percentages of over- and underskilling.

The proportion of optimal skill matching varies between 67% (in Israel) and 85% (Slovak Republic). On average, around 76% of the male full-time working employees are well matched on the basis of their skills, although considerable differences exist between countries. Furthermore, we find considerable amounts of suboptimal matching, with

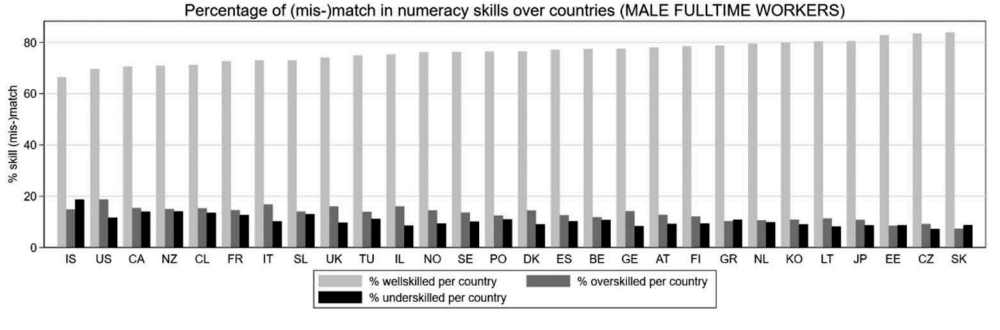

Figure 2. Proportion of skill matching and skill mismatches over countries (Male full-time workers).
Source: Pooled PIAAC-data; own calculations.

around 11% of our working sample being underskilled, and around 13% being overskilled.

We now turn to the multilevel analyses, starting with results for the whole sample of male full-time working employees as presented in Table 1. For each model, skill matching at the micro-level is the dependent variable under study. If not stated differently, all tables display average marginal effects (AME). Note that ISCO 1-digit and ISIC 1-digit are included as controls in all models.

Model 1 estimates the relation between EPL and the likelihood of optimal matching at the individual level. The AME is positive and highly significant, which means that a stricter degree of EPL is related with a higher share of optimal skill matching, just as we expected based on hypothesis H1. Thereby, the positive relation between EPL and optimal matching is almost as big as the negative association with migration background. As with all models, we re-run the analyses including micro-level confounders (Model 1a), showing that our findings hold even if we control for composition effects. Models 2 and 3 display our findings for unemployment benefits (H3) and public expenditure on active labour market policy (H4). We do not find empirical support for these hypotheses as the obtained AMEs are very small (or even 0 in the case of unemployment protection) and statistically not significant.[9] This holds if we include micro-level confounders, which is why we refute both H3 and H4. Based on these analyses, particularly EPL seems to be related to optimal skill matching.

As outlined in the theoretical section, we make use of composite policy indicators measuring the combination of enforcement and enablement, which are only available for 17 countries (Knotz 2012). We do not want our estimates to be different just because we have to rely on a different sample of countries when testing hypotheses H4a and H4b. We, therefore, test EPL on the limited sample of countries for which the indicators provided by Knotz (2012) are available. Models 4 and 4a show that our results are still valid.

Based on the reduced sample of 17 countries, Models 5 and 6 test the composite indicators for enforcement and enablement. For enforcement (H4a) we find what the theory predicts: strict enforcement of labour market participation shows a relatively big and statistically significant negative association with optimal skill matching. Although part of the variance can be explained by micro-level confounders (see Model 4a), this effect is more than twice as big as the negative association with migration background. Testing enablement (H4b) in Model 6, we find only a weak and statistically barely significant positive relation between enablement and skill matching, which even disappears when we include micro-level confounders, controlling for composition effects, and refute H4b.

To scrutinise our main findings, we take the two most important macro-level indicators — EPL and enforcement — both up in a joint model (Model 7), finding that the AME of EPL is reduced in size, but still highly significant, while the relation between enforcement and optimal skill matching disappears. Assessing the goodness of fit of our (logit) models using likelihood ratio tests, we show that the decrease in deviance is statistically highly significant for all models. Our intermediate conclusion is that EPL is a strong indicator with a positive and highly significant relation to optimal skill matching, while the composite indicators for enforcement and enablement are found to be weak.

With Table 2, we specify further analyses for EPL, testing our additional hypothesis H1a. Is the relation between EPL and skill matching different for young (age<35)

Table 1. Main models, controlling for micro level characteristics, occupational and sectoral structure (Male full-time working employees).

VARIABLES	Model 1	Model 1a	Model 2	Model 2a	Model 3	Model 3a	Model 4	Model 4a	Model 5	Model 5a	Model 6	Model 6a	Model 7	Model 7a
Fixed effects														
H1: EPL	0.046***	0.042***					0.041***	0.037***					0.035***	0.035***
	(0.013)	(0.013)					(0.010)	(0.011)					(0.011)	(0.010)
H2: Unempl. Prot.			0.000	0.000										
			(0.000)	(0.000)										
H3: Exp. ALMP					0.016	0.012								
					(0.015)	(0.014)								
H4a: Enforce.									−0.221***	−0.179**			−0.067	−0.027
									(0.078)	(0.089)			(0.073)	(0.075)
H4b: Enablement											0.125*	0.097		
											(0.070)	(0.066)		
Age		−0.003*		−0.003		−0.002		−0.004*		−0.004*		−0.004*		−0.004*
		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)
Age2		0.000*		0.000		0.000		0.000*		0.000*		0.000*		0.000*
		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)		(0.000)
Mig. Background		−0.049***		−0.050***		−0.059***		−0.066***		−0.066***		−0.067***		−0.066***
		(0.012)		(0.012)		(0.013)		(0.016)		(0.015)		(0.016)		(0.016)
Sec. Ed./Appren.		0.062***		0.061***		0.067***		0.061***		0.061***		0.060***		0.061***
		(0.013)		(0.013)		(0.015)		(0.014)		(0.015)		(0.015)		(0.014)
Tertiary Edu.		−0.004		−0.005		−0.002		−0.005		−0.007		−0.007		−0.005
		(0.016)		(0.016)		(0.018)		(0.018)		(0.019)		(0.019)		(0.018)
Random effect variances														
Country	0.043	0.037	0.061	0.052	0.07	0.058	0.145	0.012	0.023	0.021	0.023	0.024	0.014	0.012
	(0.013)	(0.011)	(0.017)	(0.015)	(0.021)	(0.017)	(0.008)	(0.006)	(0.008)	(0.007)	(0.009)	(0.009)	(0.008)	(0.006)
Observations	38,181	37,978	38,181	37,978	32,959	32,771	23,763	23,658	23,763	23,658	23,763	23,658	23,763	23,658
No. of cntries.	28	28	28	28	23	23	*17*	*17*	*17*	*17*	*17*	*17*	*17*	*17*
Likelihood ratio test	Model 1	Model 1a	Model 2	Model 2a	Model 3	Model 3a	Model 4	Model 4a	Model 5	Model 5a	Model 6	Model 6a	Model 7	Model 7a
GOODNESS OF FIT of the models														
log likelihood	−21779	−21520	−21783	−21524	−18588	−18339	−13856	−13687	−13859	−13690	−13860	−13691	−13856	−13687
Deviance[a] (D_l)	43558	43040	43566	43048	37176	36678	27712	27374	27718	27380	27720	27382	27712	27374
Decrease (D_0-D_l)[b]	130	392	122	384	106	374	88	306	82	300	80	298	88	306
Degr. of freedom	(df = 3)	(df = 6)	(df = 3)	(df = 6)	(df = 3)	(df = 6)	(df = 3)	(df = 6)	(df = 3)	(df = 6)	(df = 3)	(df = 6)	(df = 4)	(df = 7)
Chi-squared value	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***	p < 0.005 ***

AVERAGE MARGINAL EFFECTS (AMEs) based on multilevel mixed-effects logistic regression models; All figures are weighted; ***p < 0.01, **p < 0.05, *p < 0.1
All models control for occupational structure (ISCO 1-dig) and sectoral structure (ISIC).
[a]Deviance = −2*(log likelihood), see Snijders and Bosker (2012).
[b]The decrease in deviance is computed based on the specific intercept of each model (D_0).

Table 2. Testing Hypothesis 1a: Is the relation between EPL and skill matching different for young (age<35) compared to adult (age≥35) workers? (Male full-time working employees).

	Model 1	Model 1a
VARIABLES	Wellskilled	Wellskilled
Fixed effects		
EPL	0.273***	0.239***
	(0.074)	(0.072)
Young worker (Dummy = 1)[a]	0.044	0.013
	(0.164)	(0.173)
EPL*young worker (CLI)	−0.004	0.008
	(0.066)	(0.069)
Migration Background		−0.280***
		(0.068)
Secondary/Apprentice Ed.		0.351***
		(0.072)
Tertiary Education		−0.035
		(0.082)
Random effects variance		
Country	0.043	0.037
	(0.013)	(0.011)
Observations	38,180	37,977
Number of countries	28	28
Likelihood ratio test	Model 1	Model 1a
GOODNESS OF FIT of the models		
log likelihood	−21778	−21521
Deviance[b] (D_i)	43556	43042
Deviance decrease (D_0-D_i)[c]	130	390
Degrees of freedom	(df = 4)	(df = 7)
Chi-squared value	p < 0.005	p < 0.005
	***	***

LOG ODDS based on multilevel mixed-effects logistic regression models; Figures are weighted;
***p < 0.01, **p < 0.05, *p < 0.1;
Robust standard errors in parentheses; CONTROLS INCLUDE OCCUPATIONAL STRUCTURE (ISCO1) AND SECTORAL STRUCTURE (ISIC1)
[a]We tested a random slope at the country level, which only has an insignificantly small effect
[b]Deviance = −2*(log likelihood), see Snijders and Bosker (2012, 12);
[c]The decrease in deviance is computed based on the specific intercept of each model (D_0).

compared to adult (age≥35) workers? To answer this question, we include a cross-level interaction between EPL, a dummy indicating young worker, and test a random slope at the country level.

Table 2 shows that the cross-level interaction between EPL and young worker is not significant, which means that EPL does not only affect optimal skill matching of young workers but also prime age and older workers. We also tested a random slope on the country level which only has a very small effect. These results hold if we control for micro-level confounders.

Robustness

Before we outline the main results of our robustness checks, note that full results of all tests can be found in the supplemental material. As a first robustness check for our main analyses presented in Table 1, we analyse whether our results are driven by single countries, re-running the analyses for EPL and enforcement with n-1 countries.

For EPL, we find that the relation with optimal skill matching is robust and valid for all countries (Table A5). Only when we include the micro-level confounders the association decreases a little if we leave out the US-American data but stays significant at the 5%-level. The US have a lower amount of skill matching combined with a low EPL that makes dismissals less costly. Based on this, we find that the US have higher share of suboptimal matches than we would have expected based on EPL. Repeating this robustness check for enforcement (Table A6), we find that the observed associations here are partly driven by Canada and the US. These two countries score high on enforcement and low on optimal skill matching at the same time. We conclude that the negative relation between enforcing policies and optimal skill matching is particularly evident for very high values of enforcement. Generally, this robustness check still supports our theoretical arguing outlined in hypothesis H4a: If high levels of strict enforcing ALMPs are in place, the likelihood that workers are allocated to jobs that do match their skills is reduced. Next, we repeat the analyses (1) without and (2) micro-level confounders for EPL and enforcement, using a random slope at the country level (Table A7). This test shows that our estimates are not sensitive to this model specification: While the average marginal effects of both EPL and enforcement are reduced in size, significance and sign of the indicators proof to be robust.

To take into account the fact that institutions may not explain variance in outcomes of all groups of workers in the same way, and to further scrutinise the results for hypothesis H1a (displayed in Table 2), we repeat our models separately for young (age<35) and prime age/older (age≥35) male full-time workers (Table A8a+b). We find that the indicator for EPL does not change much in size. However, once we include micro-level confounders, it is only statistically significant at the 5%-level. For the reduced sample of young workers, we also find that the estimates for both Knotz-indicators for enforcement and enablement disappear. This could also be due to the large reduction both in number of countries and number of individuals. We repeat these analyses for prime age and older workers (age≥35). Here, the results are largely comparable to Table 1, the results for EPL and enforcement are robust if we only look at adult workers, while enablement now displays a positive relation that is significant at the 5%-level. This is also the case when we repeat the analyses for non-immigrant workers only, excluding respondents with a migration background (Table A9). Again, the results for EPL and enforcement are robust, while enablement is positive and significant at the 5%-level. For non-immigrants, unemployment protection is also slightly significant, but the association disappears when we control for composition effects.

We furthermore address differences between the public and private sector, running the above-outlined models separately for male full-time working employees in the public sector and in the private sector (Table A10a+b). We find that all results hold for the private sector, but not for the public sector for which we hardly find any significant correlations that can explain variance. This is an interesting result in itself and in line with theoretical reasoning. We would expect institutions like EPL to explain more variation in the private sector than in the public sector, as public sectors are highly regulated in all countries and therefore more similar across countries than private sectors.

Last we perform additional analyses, running our main models for female full-time workers (Table A11). The results for women differ from those for men. For women, EPL

loses explanatory power, when we include micro-level confounders as well as when we additionally control for enforcement; Unemployment protection is statistically highly significant, although the AME is very small; enforcement displays a statistically significant and negative relation with optimal skill matching, and – other than for men – have a positive relation that is significant at the 10%-level and robust if we control for composition effects. However, further insights would require a systematic comparison between men and women.

Discussion and conclusion

According to recent studies, skill mismatches are a 'pervasive' (Cedefop 2010) and 'persistent' phenomenon, implying that the incidence is also related to labour market arrangements (Flisi et al. 2016, 2). Against this background, the issue of optimal job-worker matching has gained importance as a topic of scientific, but also political and social relevance. Our analyses contribute to fill in a gap in existing literature by providing empirical evidence for the association between labour market policies and optimal skill matching, and by disentangling different shades of activating labour market policies that characterise todays' social policy mix of industrialised societies, examining their relation with optimal skill matching. We seek to outline the most important findings as well as related policy implications.

First and foremost, we provide empirical evidence that a higher employment protection legislation (EPL) is associated with higher shares of optimal skill matching: The stricter the degree of EPL, the more likely it is that workers are allocated to jobs that match their skill level. This is a strong and very robust finding that holds even if we control for compositional effects of the workforce, run the analysis on a reduced sample of countries, or look at subgroups of workers. Furthermore, we find that EPL does not only explain variation in skill matches for young entrants to the labour market but both adult and young workers in the same way. One explanation may be that a stricter EPL increases employer's awareness that skills must fit with the requirements. The underlying mechanism of the association that we find is either in a more careful selection of workers into jobs or in lifelong learning: Keeping workers' skills matched with jobs over the years is related to providing opportunities for learning on the job. Our results provide first indications that employers may be more selective in the process of hiring, but this could go hand in hand with more emphasis on training on the job. A robustness check also suggests that the lack of EPL can explain cross-country variation in optimal skill matching through firing decisions. The US is a country that combines a low level of optimal matching with a low EPL. The results open up a promising research area that should be further explore in future studies.

Our second major finding is that strict enforcing ALMPs are related to lower shares of optimal skill matching and thus higher shares of skill mismatch. Using composite policy indicators that capture the qualitative mix of enforcing and enabling policies, we find that: the more enforcing ALMP's are in effect, the less likely it is that workers are allocated optimally regarding their skill level. While the evidence merely holds for countries with strict enforcing policies, our findings provide first hints that strict enforcement does not lead countries in the right direction when it comes to facing the challenge of allocating the right people to the right jobs.

The additional analyses that we perform for full-time working women as compared to men provide some interesting while preliminary results as they outline major differences

between men and women concerning labour market institutions and their relation with optimal skill matching. Activating labour market policies have been particularly designed to activate social groups that have formerly been largely inactive (such as women and mothers). The analyses presented here provide first indications that this is also relevant for optimal skill matching. Further research could address selective policy effects, analysing the relation with different social policies, e.g. including family policies. While all analyses presented here are descriptively important, they provide a first step towards a thorough investigation of the causal effects of labour market institutions on skill matching at the individual level.

Notes

1. A full list of countries is entailed in Table A1 in the supplemental material.
2. For more detailed information about the PIAAC dataset and technical issues see OECD (2013b, 2016).
3. We include a description of the debate and the commonly used measures in the supplemental material.
4. We compute the standard deviation of the 10 plausible values of the individual numeracy scores in PIAAC, pooling over ISCO 2-digit categories. We use the repest-command in Stata 15 to properly take into account the PIAAC replicate weights.
5. Van der Velden and Bijlsma (2018) show that the total explained variance does not change if they use 3-digit instead of 2-digit ISCO categories.
6. We could have simply computed the simple mean per country but then we would have lost many occupations (see Pellizzari and Fichen 2013). Instead, we decided to just exclude the very small occupation-country-cells with less than 25 observations.
7. As a robustness check, we make use an alternative indicator that captures the total spending on ALMP per unemployed workers *as percentage of GDP per capita*, which is provided by the OECD Employment and Labour Market Statistics database 2016.
8. Country scores on all macro-level indicators are displayed in the supplemental materials.
9. As a robustness check, we re-ran Model 3 using an alternative indicator for public spending per unemployed worker as percentage of GDP per capita (OECD 2016). This indicator, too, does give AMEs close to 0 that are statistically not significant (see Table A4 in the supplemental material).

Acknowledgments

We would like to thank the participants of the Transitions in Youth 26th Annual Workshop 2018 (Mannheim) as well as Paolo Barbieri, Josef Schmid and Martin Groß for valuable comments and suggestions.

Disclosure statement

No potential conflict of interest was reported by the authors.

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